JC18 Rec'd PCT/PTO 10 DEC 2001

FORM PTO-1390 (Modified) (REV 5-93) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE **TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371**		ATTORNEY'S DOCKET NUMBER 016915-0253
		U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) Unassigned 10/009346
INTERNATIONAL APPLICATION NO. PCT/EP00/05329	INTERNATIONAL FILING DATE 06/09/2000	PRIORITY DATE CLAIMED 06/09/1999

TITLE OF INVENTION
METHOD AND DEVICE FOR SYNCHRONISATION IN THE ENCODING AND DECODING OF DATA THAT ARE PRINTED IN DATA TAPES

APPLICANT(S) FOR DO/EO/US
Bernhard WIRNITZER, Andreas BRUGGER, Tilmann KRUEGER, and Detlev MEINERZ

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   - ☒ has been transmitted by the International Bureau.
   - ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   - ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   - ☐ have been transmitted by the International Bureau.
   - ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   - ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).
11. ☒ Applicant claims small entity status under 37 CFR 1.27 .

Items 12. to 17. below concern other document(s) or information included:

12. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
13. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
14. ☒ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ Other items or information: OTHER

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U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
Unassigned 10/009345	PCT/EP00/05329	016915-0253

18. ☒The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5): Search Report has been prepared by the EPO or JPO.................................$890.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482)...$710.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2) $740.00		
Neither international preliminary examination fee (37 CFR 1.482) nor International search fee (37 CFR 1.445(a)(2)) paid to USPTO $1,040.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$890.00	
Surcharge of $130.00 for furnishing the oath or declaration later than 20 Months from the earliest claimed priority date (37 CFR 1.492(e))	$130.00	

Claims	Number Filed		Included in Basic Fee		Extra Claims		Rate		
Total Claims	16	-	20	=	0	×	$18.00	$0.00	
Independent Claims	1	-	3	=	0	×	$84.00	$0.00	
Multiple dependent claim(s) (if applicable)							$280.00		

TOTAL OF ABOVE CALCULATIONS =	$1020.00	
Reduction by ½ for filing by small entity, if applicable.	$510.00	
SUBTOTAL =	$510.00	
Processing fee of $130.00 for furnishing English translation later the 20 months from the earliest claimed priority date (37 CFR 1.492(f). +		
TOTAL NATIONAL FEE =	$510.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +		
TOTAL FEES ENCLOSED =	$510.00	

				Amount to be: refunded	$
				charged	$

a. ☒ A check in the amount of $510.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. 19-0741 in the amount of $0.00 to the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 19-0741. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Foley & Lardner
Customer Number: 22428

PATENT TRADEMARK OFFICE

34371

SIGNATURE

Glenn Law

NAME RICHARD L. SCHWAAB

REGISTRATION NUMBER 25,479

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Attorney Docket No. 016915-0253

In re patent application of

Bernhard WIRNITZER et al.

Serial No.: Unassigned

Filed: December 7, 2001

For: METHOD AND DEVICE FOR SYNCHRONISATION IN THE ENCODING AND DECODING OF DATA THAT ARE PRINTED IN DATA TAPES

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination of the above-identified application, Applicants respectfully request that the following amendments be entered into the application:

IN THE CLAIMS:

Please replace claims 7, 9, and 10, annexed to the international application during preliminary examination, with amended claims 7, 9, and 10 as follows:

--7. (Amended) Method according to claim 5, **characterized in that** for representing the information content of a cell comprising different fields characteristic patterns existing in the cell are used.

9. (Amended) Method according to claim 7, **characterized in that** the characteristic patterns comprise colors which appear in different degrees of brightness to the sensor.

10. (Amended) Device for performing a process according to claim 1, **characterized in that** the sensor data are supplied to a detector, which determines from the latter the position of a cell in relation to the sensor coordinate system and its information content.--

Please add new claims 12 through 16 as follows:

--12. (New) Method according to claim 6, **characterized in that** for representing the information content of a cell comprising different fields characteristic patterns existing in the cell are used.

13. (New) Method according to claim 8, **characterized in that** the characteristic patterns comprise colors which appear in different degrees of brightness to the sensor.

14. (New) Device for performing a process according to claim 2, **characterized in that** the sensor data are supplied to a detector, which determines from the latter the position of a cell in relation to the sensor coordinate system and its information content.

15. (New) Device for performing a process according to claim 3 **characterized in that** the sensor data are supplied to a detector, which determines from the latter the position of a cell in relation to the sensor coordinate system and its information content.

16. (New) Device for performing a process according to claim 4, **characterized in that** the sensor data are supplied to a detector, which determines from the latter the position of a cell in relation to the sensor coordinate system and its information content.--

REMARKS

Applicants respectfully request that the foregoing amendments to Claims 7, 9, and 10 and new Claims 12 through 16 be entered in order to avoid this application incurring a surcharge for the presence of one or more multiple dependent claims. A marked-up version of the claims showing the changes made is attached herewith.

Respectfully submitted,

34371

for Richard L. Schwaab
Registration No. 25,479

December 10, 2001
Date

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(202) 672-5300

VERSIONS WITH MARKINGS TO SHOW CHANGES MADE

7. Method according to [at least one of claims 5 to 6] claim 5, characterized in that for representing the information content of a cell [consisting of] comprising different fields characteristic patterns existing in the cell are used.

9. Method according to [any one of claims 7 or 8] claim 7, **characterized in that** the characteristic patterns [consist of] comprise colors which appear in different degrees of brightness to the sensor.

10. Device for performing a process according to [at least one of claims 1 to 4] claim 1, **characterized in that** the sensor data are supplied to a detector, which determines from the latter the position of a cell in relation to the sensor coordinate system and its information content.

dSm 4151 PCT/US

Applicant or Patentee: Bernhard WIRNITZER et al.
Serial or Patent No.: Unassigned Atty. Dkt. No. 016915-0253
Filed or Issued: December 10, 2001
For: METHOD AND DEVICE FOR SYNCHRONISATION IN THE ENCODING AND DECODING OF DATA THAT ARE PRINTED IN DATA TAPES

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.27) — SMALL BUSINESS CONCERN

I hereby declare that I am
( ) the owner of the small business concern identified below:
(X) an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN: DATASOUND GESELLSCHAFT ZUR ENTWICKLUNG UND VERMARKTUNG DIGITALER AUDIO- UND INFORMATIONSSYSTEME, GmbH

ADDRESS OF CONCERN: Rheinuferstrasse 9
D-67061 Ludwigshafen, Federal Republic of Germany

I hereby declare that the above-identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18 and reproduced in 37 CFR 1.27, for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled METHOD AND DEVICE FOR SYNCHRONISATION IN THE ENCODING AND DECODING OF DATA THAT ARE PRINTED IN DATA TAPES by inventors Bernhard WIRNITZER et al., described in

( ) the specification filed herewith
(X) application serial no. PCT/EP00/05329, filed June 9, 2000
( ) patent no.______________ , issued __________________

If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.27(a)(1) if that person made the

invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.27(a)(2) or a nonprofit organization under 37 CFR 1.27(a)(3). * NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities: (37 CFR 1.27)

NAME: ______________________________
ADDRESS: ______________________________
( ) INDIVIDUAL( ) SMALL BUSINESS CONCERN( ) NONPROFIT CORPORATION

NAME: ______________________________
ADDRESS: ______________________________
( ) INDIVIDUAL( ) SMALL BUSINESS CONCERN( ) NONPROFIT CORPORATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate: (37 CFR 1.27.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING: Johannes Hamann
TITLE OF PERSON OTHER THAN OWNER: Managing Director
ADDRESS OF PERSON SIGNING: Tannhäuserring 178, 68199 Mannheim
SIGNATURE: ______________ DATE: 27.07.02

DATASOUND
Gesellschaft zur Entwicklung und Vermarktung digitaler Audio- und Informationssysteme mbH
Rheinuferstrasse 9 · 67061 Ludwigshafen

10090554.030402

5 / PRTS

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10/009345

Method and Device for Synchronization in the Encoding and Decoding of Data that are Printed in Data Tapes

The invention relates to a method for synchronization in the encoding and decoding of data on printed supports, in particular of data tapes containing data with information stored two-dimensionally, which may be read by a reading device comprising a linear or surface sensor, in which process during encoding of the data suitable two-dimensional synchronous information is integrated in the data code, the said information being used during decoding for adjusting a two-dimensional adaptive synchronous filter, as well as to a device for carrying out the process, in which context the optically recordable information is typically read by a CCD-line sensor or a CCD-image sensor.

For storing relatively small amounts of information on sections, bar codes having a one-dimensional structure have been known for a long time and are in general use. In order to encode information, bars and their spacings are applied to the object in different widths. A reading device may capture the bar pattern and decode the information. Although the bar pattern covers a surface, the information is arranged only one-dimensionally. If scanning by the reading device is performed obliquely across the bars, the bar widths change, but the ratio of the two widths remains constant so that synchronization between scanning and bar pattern is very simple and generally known. The data density of such codes, however, is a few bits only per square centimeter of printing area, due to the relatively coarse, one-dimensional data structure.

Two-dimensional bar codes, which are less common, contain somewhat larger amounts of information. For data tapes having bar codes, various codes, for example, EAN, are customary, depending on the field of application. Increased data reliability by the provision of redundancy is illustrated in US 3 211 470.

In order to attain a higher data density, data tapes are composed of a plurality of data lines and are supplemented by structures for synchronization. WO 86/05906 describes such a data tape, containing specific synchronization areas serving to adjust the optical reading device to the data lines and to control the so-called scan rate at which the reading device captures line by line while being guided over a data tape. Within a line one interpolates linearly, i.e. synchronization is not performed within the line. In DE 41 07 020 A1 such synchronization areas are evaluated mathematically.

In EP 0 670 555 A1 the synchronization areas are provided in the form of margins of sections of the data tape. The company Cobblestone Software Inc. describes a process at www.paperdisk.com having synchronous labels serving as a two-dimensional extension of bar codes. By this measure they aim at accommodating in the form of so-called data tiles data densities of up to 4 megabytes on a sheet of 8 x 11 inches.

A drawback of the known data tapes, consisting of a multitude of data lines, i.e. of information points arranged in lines and columns, is the low attainable data density.

The reason for this resides in the fact that the methods and devices used for encoding and decoding the stored data presuppose that the arrangement of data lines and, therefore, also of the information points is sufficiently linear with regard to the resolution of the sensor, that an intended rectangular data structure of data lines remains at least quadrangular with straight data lines, even if affected by interferences and that the data structure may be transformed

back to the original configuration by a turning operation and/or a linear rectification.

These prerequisites can, however, only be complied with readily in the case of relatively small amounts of information, since it is very difficult and costly to technically produce, with regard to the dimensions of a data point, long straight lines, i.e. lines consisting of many data points and, in addition, to prevent the deformation of the data lines due to adverse influences, such as, for example, humidity in the case of a data carrier made of paper and, moreover, to represent them in straight lines on the sensor of the reading device.

For this reason it was proposed in EP 0 670 555 A1 to divide up the data field into many zones each having its own synchronization frame. The transformation of each of the zones captured by the sensor into the target co-ordinates for attaining the originally intended data structure, is performed there from the outside, controlled via the synchronization frame and, as a result, irrespective of the contents of the zone. A desirable, internal synchronization within the zone does, however, not take place.

Furthermore, from US 5,706,099 a process for capturing encoded data tapes is known, wherein separate cells are assumed. Spacing is in this case inevitable, as information in the cells can otherwise not be distinguished. A high data density is, therefore, not attainable, not intended and also not required for the purpose of application described there (dispatch by mail).

The known techniques provide, therefore, only a low, storable, error-reduced readable and decodable information density. The area so required for certain amounts of data is too large for practical application.

Reducing the size of the printing dots is a possibility for increasing the data density in the known codes. However, in this case, typical image defects such as distortion, astigmatism, coma and shadow images, as they occur by reflections on parallel plates, increase distinctly. The printing process and the image optics then give rise to the fact that the synchronization structures for the reading device appear blurred or distorted, that synchronization to the code fails despite expensive technology, and that decoding becomes incorrect and, therefore, useless.

In order to record large amounts of data, the technology normally uses two basic principles, namely the recording of data on parallel tracks on a tape-like data carrier and the recording of data on parallel or spiral tracks on a rotating data carrier.

For both basic principles a linear arrangement of data lines is selected, in which context, in the case of lower data density, the precise track guidance depends on the precision of the mechanical guidance of tape and writing/reading head while, in the case of higher data density, a reading head follows the respectively selected data line. The signal produced by the reading head from the recorded information of the data carrier experiences temporal, i.e. one-dimensional synchronization according to known methods.

These methods of synchronization have been designed only for one-dimensional synchronization with time, even if objects are concerned which are to be represented in a geometrically two-dimensional manner. Thus, synchronization of a television image, for example, is limited to pure time synchronization with temporal synchronous impulses for line and picture.

The known synchronization methods do not make it readily possible to use a sensor consisting of a large number of sensor elements, arranged in linear or planar fashion, such as CCD-line sensors or CCD-surface sensors. Since in the case of these image sensors for the transfer of information from the data carrier onto the sensor a relatively great number of data points is scanned simultaneously, the sensor would have to follow the geometrical pattern of the data points simultaneously represented on it, for which purpose, however, dot scanning instead of linear scanning would be required. If the sensor cells are not substantially smaller than the synchronization screen, synchronization will fail in this case.

The disadvantages of smaller sensor cells are, however, the low light sensitivity, the high price of the sensors and the large amount of data during read-out.

A further drawback of the known methods is the susceptibility to dirt accumulations, wear and tear or deformations of the data carrier. In addition, the coarse data and synchronization structures are perceptible to the human eye and may be a source of interference in various applications and also when overlaying additional visual information.

For the attainable amount of data of a two-dimensional data tape, its dimensions and the perfectly decodable data density are decisive. The greater these two values are selected, the more complex and difficult the required synchronization will become.

It is, therefore, the object of the invention to permit a high data density on a data tape, where encoding, error-reduced decoding and correct synchronization, even in the event of considerably interfering, even non-linear influences, is ensured and that, moreover, the code structures may be so dimensioned that they cannot be perceived by the naked eye and that additional visual information may be overlaid on the stored information.

The object is attained by a method for synchronization in the decoding of stored information filed on data tapes having a high data density in cells positioned two-dimensionally on the data tape by means of a surface or line sensor, in which context at first a specification is established, describing the relative position of the fields of the sensor in relation to the position of the cells and in that this specification is corrected continuously in both dimensions by means of the relative position detectable by sensor signals of the sensor fields of edges or inner structures of the cells and by a method for synchronization in the encoding of this information, in which context two-dimensional synchronous information is integrated into the inner structure of the cells positioned two-dimensionally on the data tape and containing the stored information, as well as by a device comprising a detector to which the sensor data are fed and which detects from these data the position of a cell in relation to the sensor coordinate system and its information content.

By synchronization generally the bringing about of the synchronism between two procedures is understood; accordingly, a time relation suffices. For a method realising synchronization this results, therefore, also in the relation to one single dimension, namely time. In the transfer of methods and specifications of the communication technology to optics, time is normally replaced by a spatial dimension so that the concept of synchronization is applied analogously to bringing about image specifications.

By specifications in the context of the invention rules for plotting one system of coordinates on another are understood. This may also mean relations, equations, functions or algorithms. The technology refers here to "image

specifications". In order to carry out a process according to the invention, the conversion of the specifications into algorithms may be advantageous.

Synchronization of the information read from the data tape by the sensor of a reading device is two-dimensional in accordance with the invention and, due to image and scanning errors as well as variations of the area to be scanned, for example, due to humidity in the case of a data carrier of paper, relates to a system of coordinates, which is possibly divided neither orthogonally nor linearly nor uniformly.

Only in the event of a relatively small data density and small superficial extent of a section of the data tape to be read, limited by synchronous frames, synchronization within such a region, i.e. internal synchronization, may be dispensed with, the resultant system of coordinates of the section image may be approximated linearly and the read-out information may be transformed by normal coordinate transformation into the target coordinate system corresponding to the original data.

According to the invention, during encoding of the data suitable two-dimensional synchronous information is integrated into the patterns defined by the data and used during decoding for adjusting a two-dimensional adaptive synchronous filter so that even data tapes having large dimensions, which comprise only a single section to be read, not interrupted by synchronous labels, can be encoded very densely and at a low error rate.

In the process a data tape is subdivided two-dimensionally into periodically repeatable cells. On the other hand, the information to be encoded and which is stored in those cells is structured at least three-dimensionally, one dimension corresponding, for example, to the length of the data tape, another to its width and the third one to the information depth of each cell of the data tape.

In special cases each one of the three dimensions may have the length 1, for example, if the data tape consists of one line or one column only or if only one bit per cell is stored.

The addition of further dimensions according to technical characteristics of a data tape is likewise possible. Thus, a dimension may, for example, correspond to the depth in the data tape, in the case of multi-layered data tapes one or more may correspond to the color dimensions of the color applied to the data tape for the code.

High information densities may be attained advantageously in that in one cell a plurality of information bits is stored, each possible combination of information bits, storable in a cell, having assigned to it a pattern of its own.

The cells are preferably of rectangular shape and are assembled orthogonally. They may, however, have different shapes as well and may, e.g., be joined into a data tape in a herringbone-like manner. The cells may, moreover, consist of one or a plurality of fields.

In an extended system of coordinates, which, viewed across the surface of the data tape, has no accurately known or at least constant division nor an accurately known or at least constant angle between the axes, the system of coordinates must be synchronized continuously in both axes during a continuous scanning process. Only in this way is it made possible to continuously assign to the target coordinate information from a cell of the data tape, determined by the image intensity of the fields of this cell detected by the sensor.

According to the invention, a mathematical model of synchronization, describing a representation of coordinates of the data tape in the target coordinate system, non-linearly distorted due to various effects such as humidity or optical image errors, is corrected in a continuously adaptive manner for purposes of adaptive control.

A two-dimensional grid consisting of quadrangular meshes requiring a relatively fine structure, i.e. small mesh size and in which the coordinates are linearly interpolated two-dimensionally within a mesh, serves advantageously as the base structure of this mathematical model. However, a two-dimensional spline is preferred, for example, a B-spline, which requires considerably less support points but which is very well adaptable to the properties of the control path.

In the event that each cell consists of one field only, the number of those cells containing the same information is limited in a particularly preferred embodiment of the invention with regard to further dimensions (e.g. length and width of the data tape).

The internal two-dimensional synchronization is then performed according to the invention at the cell edges. If, for example, rectangular cells are used in dense, orthogonal packing, then by way of the transitions between cells containing different information in one of the two dimensions of the data tape, e.g. in line direction, the column synchronization information to be assigned to the current line position is established from the position of the transition. Via the transitions between cells containing different information in the second dimension, e.g. the column direction, the line synchronization information to be assigned to the current column position, is then established.

The advantage of limiting the number of cells containing the same information in the second dimension, the column direction, for example, is that it prevents the representation of more than one adjustable number of the same lines or same portion of lines on the data tape.

A number of suitable methods exists which may be used according to the invention in order to attain these objects; these may be selected individually or in combination. Thus, the capturing, for example, of information regarding a number of repetitions, additionally inserted synchronous patterns, shifting the position of data codes within a cell or column, the recording of parity bits having an uneven parity for an odd number of data bits or codes to be

encoded, ensuring that not all bits in the codes resulting from data bits and parity bits, have the value ZERO or ONE.

Furthermore, methods such as those used for the reduction of data to be transferred in facsimile processes are also suitable.

If an internal cell structure in the encoding of one bit per cell is dispensed with, then a black cell, for example, represents a ZERO, a white cell a ONE. Two-dimensional synchronization of the reading-out of such a data tape according to the invention can then not be performed in an inner structure of the cell, but only on its outer edges, that is to say at the point, where varicolored cells adjoin one another.

Such transitions may be utilized for two-dimensional synchronization, in which context transitions are used extending predominantly horizontally to column synchronization as defined by the target coordinate system, and those extending predominantly vertically in relation to line synchronization. In the process the direction of the transition may be taken into account in order to include certain properties of the control-technical path, such as, for example, encoding, printing the data tape and scanning. In this manner, it is possible to compensate for printing ink with a tendency to run by shifting the transition from black to white into the direction of white.

The image of possible patterns of a cell expected on the sensor after capturing by the reading device, depends on various parameters, *inter alia*, for example, the position of the cell on the data tape, the printing ink, properties of various data carrier materials, uneven scanning or optical distortions.

The cells are designed advantageously with regard to their shape, position and configuration so as to be produced readily and reliably by means of the transfer techniques employed and to be recognizable as well as possible after having been transferred by the reading device. Thus, considerable improvements e.g. in printing, may be attained in that the desired printing point is created by a finer exposure screen, i.e. a printing area consisting of a

plurality of exposure points is composed. As a result, internal structures of the fields can be brought about, which can compensate for interfering properties of the printing process.

Cells may, moreover, consist of a plurality of fields.

By selecting the shape and position of the cells and/or the fields in the cells, it is possible to take into account technical marginal conditions of the path between encoding of the desired information and its decoding, such as, for example, running printing ink, lack of sharpness of optics used and/or anisotropic behavior of members of the path.

Thus, exposure means used in printing technology have an orthogonal coordinate system of their points to be exposed. The resolution of the half tone screen is often as little as eight micrometers, further refinements have to be assumed. When printing a data tape, it cannot necessarily be assumed that such fine printing points can be produced reliably.

Accordingly, it is advantageous to select a coarser dot screen for the data tape. Thus, shape and/or positioning of the dots on the data tape may be designed by the selection of the half tone dots of the exposure means, determining a printing point, and their position in its coordinate system. If the exposure means has, for example, a screen of eight micrometers, then, in the case of a printing point size of 32 micrometers, each printing point may be composed of 16 exposure points and may be positioned on the data tape at eight micrometers of local resolution.

It is preferred to so design the two-dimensional pattern formed by the cells that it cannot be resolved by the human eye. This is attained in that the geometrical structure within the cells is finer than the local resolution by the eye and that the average color of neighboring cells is identical. According to the invention, any of the possible items of information of a cell is assigned a characteristic, two-dimensional pattern. Thus, a division of the cell into two rows of two fields each is useful, for example, in the case of an information depth of one bit per cell. Of the 16 possible patterns, six are half black, of

which, for example, those two are selected as characteristic ones, which have two black fields in a diagonal arrangement, in which case the value ZERO is allocated to the characteristic pattern in the one diagonal direction, while the value ONE is allocated to that pointing in the other direction. The pattern to which the value ONE has been allocated is thus replaced by its negative image for the value ZERO to be encoded.

This is also possible for more complex internal structures of a cell, for example, for a black cross on a white background for the value ZERO and a white cross on a black background for the value ONE.

For such an internal structure of cells the information required on the position for synchronization may be established for each individual cell in both dimensions and be supplied to the adaptive control means. As a result, synchronization may be performed in a very fine and rigid manner, whereby pronounced distortions may be compensated for. Likewise, it is possible to provide in a cell having two rows of two fields each, four characteristic patterns corresponding to the information of 2 bits to be encoded, or even six characteristic patterns which are all half black. Even then a uniform unstructured gray area is perceived by the eye, irrespective of the information encoded.

In the case of greater information depth of the cells the corresponding number of necessary, different, characteristic patterns increases, for four bits per cell to sixteen, for example. An advantageous division of the cell into six fields permits the use of up to 20 characteristic patterns, provided one selects as a prerequisite that half of all fields should be black. If lesser demands are made on the uniformity of the average color of the cells, even those having only two white or black fields may be used for the definition of the characteristic patterns, in order to so obtain, for example, 32 characteristic patterns with which five bits per cell may be encoded.

When selecting the characteristic patterns used, which meet the selected, given marginal conditions, preferably two criteria are used from among a

larger number of possible characteristic patterns, namely, firstly, avoidance, to a large extent, of data-technically similar patterns and, secondly, avoidance of optically disturbing patterns.

The information to be encoded may make decoding by certain methods more difficult, in particular when using tolerances. Thus, with the NRZ-method the number of successive bits having the same value ZERO or ONE, as the case may be, can only be established correctly if the cycle is constant. For the three-dimensional structuring of the information to be encoded, a limitation of the running length of sub-structures containing the same information is therefore advantageous for improving synchronization and/or for the optical configuration. The information to be encoded may also give rise to structures, recognizable with the naked eye. In this case, it is advantageous to replace interfering sub-structures by other sub-structures to which the desired information is allocated.

Overlaying of image-like information, recognizable by the human eye, may be performed according to the invention by varying the printing ink, in which context the latter may remain largely undetected by the reading device. If, for example, an optical reading device having a red window, or red illumination, is used, then the printed colors appear without the red portion, i.e. green, yellow, blue or black, constituting a similar image intensity for the reading device, but not for the eye.

While in known codes having a high data density wavy supports, distorted paper carriers and slight unevenness in the movement of the reading device are particularly critical, since synchronization onto the code and storing of the established data without misalignment in the target coordinate system fails, it is possible with the method according to the invention, despite considerable waviness, to maintain synchronization during the scanning procedure. Even the areas with print patterns otherwise required for synchronization may be dispensed with. This is of particular importance to a data tape of graphically attractive design.

For decoding, the data tapes are read in by a device, the local resolution of which is advantageously at least twice as high as that of the human eye. As a result, the sensors of the reading device have a local screen. If the sensor in question is a line sensor, moved relative to the data tape, the local scanning frequency may vary with the scan rate in the direction of motion while the local scanning frequency transversely thereto may vary due to sensor tolerances and image errors of the optics, depicting the data tape on the sensor.

In the following the invention is elucidated by way of drawings and embodiments. There are shown in:

Fig. 1 possible encodings of a cell having two rows of two fields each,

Fig. 2 possible encodings of a cell having the same average brightness with three rows of two fields each;

Fig. 3 an example of a cell for bleeding printing ink,

Fig. 4 two different screens for positioning the cell according to Fig. 3,

Fig. 5 the schematic structure of a device for performing the processing steps according to the invention for decoding the code and

Fig. 6 a simplified illustration by way of example of printed cells both in the sensor coordinate system as well as in the target coordinate system.

Figure 1 shows all possibilities of encoding a cell having two rows of two fields each. If, for example, the value ZERO is allocated to a white field and the value ONE to a black field, then, in possible value weighting of the fields, the hexadecimal coding, stated in each case below the cell, of between 0 corresponding to 0H (decimal 0) and F corresponding to FH (decimal 15) results. If only one binary digit of information is to be encoded in such a cell, the selection of the cells 6, for example for ZERO, and 9, for example for ONE, is advantageous, both having the same average brightness and

resulting in a particularly fine structure with regard to visual assessment. By way of a simple detector these two cells may firstly be distinguished from the others, secondly, the information bit may be decoded and thirdly, the position of the cell with regard to the screen of the target coordinate system may be determined in a particularly precise manner and may thus be used for controlling synchronization.

Out of the 64 possibilities for encoding a cell having three rows of two fields each, **Figure 2** shows 20 possibilities, where half the fields of a cell are black. If, for example, the value ZERO is assigned to a white field and the value ONE to a black field, in a possible value weighting of the fields the hexadecimal coding, stated in each case below the cell, of between 00 corresponding to 00H (decimal 0) and 3F corresponding to 3FH (decimal 63) results. If only the 20 possibilities illustrated are used, a constant average brightness is obtained. In order to control synchronization, it is particularly advantageous to dispense with cells having the hexadecimal coding 15, 2A, 31 and 32, since the cells having the hexadecimal coding 15 and 2A in vertical direction cannot be separated screen-reliably from the hexadecimal coding 31 and 32 in horizontal direction during decoding in a column or a row containing the same information. In order to increase decoding reliability, a selection of the encodings of the cells to be used may be made in terms of factors which are common with regard to data reliability, such as the Hamming-distance or factors of simple setting up or effectively realising the detectors.

Figure 3 shows an example of a cell configuration or a field encoding of a rectangular cell designed in order to be able to prevent bleeding colors from mixing with the color of neighboring cells during printing.

Figure 4 illustrates the periodic repetition of cells containing random information. For example, if the all white cells correspond to the value ZERO, the partially black cells will correspond to the value ONE. In section A of Figure 4 it is shown that protection against mixing of printing ink of neighboring cells with the cell according to Figure 3 in an orthogonal system of coordinates is attained only in part, while it can be seen in section B that in

a changed system of coordinates the ink would have to run very far indeed in order to merge with neighboring cells.

Figure 5 shows schematically the essential parts of a device for performing the claimed process. The preferably digitalized sensor data 10 of the sensor 1 are fed to the detector 8 and are processed from there by the synchronous position decoder 3 and pattern recognition means 4 by using the detection parameter 11. In the process, the synchronous position decoder 3 establishes the deviation of the actual position of the sensor data 10 from the next synchronous position, passing same on for actual position calculation 6 in the form of the synchronous key 13. The actual position calculation 6 calculates the probable, actual position from the synchronous keys of the two-dimensionally adjoining sensor data, passing on the result to the parameter calculation means 5 as position information 15 and to the outside for further use. In the pattern recognition means 4 the detector 8 establishes whether one of the characteristic patterns and if so, which, is present and passes on the corresponding pattern key 14 to the bit pattern allocation 7, determining the bit sequence 16 to be issued. In the parameter calculation means 5 the new detection parameters 12 are calculated from the position information 15 and the detection parameters stored previously in the parameter storage means 2 and are then stored in the parameter storage means 2. They are available there to the detector 8 for the following cycle. The parameters for the detector 8 take into account, *inter alia*, regional scale errors, position shifts and distortions, i.e. those of small regions as well. The position information 15 may serve to determine the address, under which the bit sequence 16 may be filed in a result storage means.

Figure 6 shows a simplified, exemplified illustration of printed cells both in the sensor coordinate system as well as in the target coordinate system. The sensor coordinate system has been selected arbitrarily as the reference system without limiting the generality in this illustration. It has columns to serve as its one dimension, of which those denoted by T-2 to T+8 are illustrated while it has lines to serve as its second dimension, of which those denoted by U-2 to U+8 are shown. Accordingly, the target coordinate system

has two dimensions, columns N-1 to N+9 as well as the cells M-1 to M+5 being shown. Relative to the sensor coordinate system the target coordinate system is split neither linearly nor evenly, it is in itself not orthogonal either. Relative to the sensor, the illustration of the printed pattern is very simplified as well.

Thus, the only place where the transitions between black and white are still sharp-edged is on the data tape, the image on the sensor, however, is blurred, the width of the transitional region, in the case of high data density, is approximately within the same order of magnitude as the sensor division corresponding to the division of the sensor coordinate system.

If a line sensor is used to serve as a sensor, the division of the sensor coordinate system in one axis is determined by sectioning the sensitive areas of the sensor, in the second axis it is determined, for example, by the scan rate of the sensor relative to the data tape so that a non-constant scan rate results in a distortion, which may, however, be calculated as part of the target coordinate system and which may be used, if desired or required, for controlling the scan rate.

In the coordinate system of the original information, which should correspond to the target coordinate system, the example shown here with hatched lines of a printed pattern is so selected that the cells having the coordinates (M, N+6), (M+1, N+6) and (M+2, N+5) should be black. It is shown how, due to the printing process, the edges of the printed pattern, for example, do not match the existing cell borders of the target coordinate system. In addition, there is the lack of definition of the image on the sensor as well as the local transfer function of the sensor itself.

During processing of the data established by the sensor, which correspond, for example, to the values of brightness allocated by the sensor to each field of the sensor coordinate system, the individual fields are utilized differently: for the field (T+4, U-3) there is no utilization, as its position corresponds to a corner of the target coordinate system;

the fields (T+3, U+1) and (T+4, U+1) are used for synchronizing the column coordinate N+6, since they represent a black-white-transition within a line of the target coordinate system;
the fields (T, U+5) and (T, U+6) are used for synchronizing the line coordinate M+2, since they represent a white-black-transition within a column of the target coordinate system;
the field (T+5, U+1) is used to serve as data information for the target coordinate (M, N+6), because it is sufficiently remote from the edges of the target field;
for the fields (T+4, U+2) and (T+4, U+3) there is no utilization, as there is no black-white or white-black-transition, which might be used for synchronization.

Accordingly, the sufficiently widely positioned color transitions within a line of the target coordinate system may contribute to column synchronization, the sufficiently widely positioned color transitions within a column of the target coordinate system to line synchronization while the sufficiently widely positioned fields of the sensor coordinate system within line and column of the target coordinate system may be used for data determination of the corresponding cell.

If one operates at high data density, the cells of the target coordinate system are relatively small, the fields of the sensor coordinate system even smaller. If data of a data tape must be read out within a short time-span, this must be performed at high frequency, for example, at a reading speed of several millions of sensor fields per second.

In the process according to the invention, by adequate synchronization alone, those sensor fields, which may contribute to synchronization or data determination may be established, for example, the five sensor fields positioned closest within a cell of the target coordinate system to the cell edge centers or the cell center.

When considering the neighboring cells the average number of sensor fields per cell to be taken into account may be decreased considerably even further.

If, e.g., two neighboring cells have the same color, color transition is dispensed with. The number of sensor fields per cell to be taken into account may be decreased further in that in the regions, where the fields to be used for synchronizing a dimension, for example, the line of a target coordinate system, are positioned very close to one another, only a subset is actually used for synchronization.

If the sensor values, brightness of the sensor fields, for example, are processed with analogous or digital resolution by more than one bit, the coordinates of a brightness transition from the brightness values of the associated sensor fields may not only relate to the edges of the sensor coordinate system, but may be resolved even further. Accordingly, data determination may take place by that sensor cell, which among the sensor cells not positioned in the vicinity of the cell edge has the extreme, i.e. maximum or minimum value of brightness.

When processing binary brightness values, i.e. a resolution of one bit only, the coordinates of a transition of brightness may initially relate only to edges of the sensor coordinate system. However, even in this case the positions of the cell borders may be estimated more precisely by including neighboring brightness transitions, shown, for example, in the example according to Figure 6 by jointly taking into account the transitions (T+3, U+1)-(T+4, U+1) and (T+2, U+4)0-(T+3, U+4) and (T+1, U+7)-(T+2, U+7). Accordingly, data determination may be performed by producing the mean value of the brightness values of the sensor cells not positioned in the vicinity of the cell edge by limiting value scanning.

The process of representing the existing sensor coordinate system on the desired target coordinate system may be performed in the form of a two-dimensional polygonal grid, as it is used for finite-element methods, by two-dimensional splines or multi-dimensional approximation methods.

The coordinates of the target coordinate system required for storing the established data are normally in whole numbers. It may, nevertheless, be

advantageous to resolve at a higher level the position of sensor fields in the target coordinate system. If the column in the sensor coordinate system is denoted by x and the line by y, the column in the target coordinate system by a and the line by b, then the representation of the sensor coordinate system on the target coordinate system may be attained by two specifications f and g with a=f(x,y) and b=g(x,y). These specifications may, *inter alia*, be polygons, polynomials, reference curves or B-splines, but also step-wise methods.

When using a line sensor, the brightness values of the fields of a sensor line are captured simultaneously and supplied sequentially at high frequency to further processing means. It is advantageous in this case, to produce, at the beginning of processing the brightness values of a sensor line, the specifications fy and gy with a=fy(x) and b=gy(x) from the specifications f and g, which then depend only on one variable x.

Advantageously, a purely incremental evaluation of the specification fy and gy is adequately considered as well, since the brightness values arrive sequentially. If the specifications are realized accordingly, the decision on whether the use of the brightness value for a field is of significance and if so, of which, may be taken by individual bits of a digital representation of the values a(x, y) and b(x, y). Thus, the combination 00 may represent the first two post-comma bits for a front edge position, the combination 11 may represent the rear edge position and the combinations 01 and 10 the central position. For synchronization one would then use, for example, only sensor fields having combinations indicating a central position in one dimension, an edge position in another, for data determination only those having a central position in a cell of the target coordinate system in both dimensions.

If digital signal processors are used, the specifications pertaining to the methods in floating-point arithmetics or fixed-point arithmetics may be realized. It may be advantageous to base portions of the methods on processing by way of tables in the sense of image procedures. In order to keep the required storage space as low as possible, storage of brightness values of sensor fields not required or not required any longer may be

dispensed with. At the same time this reduces processing to the required magnitude.

In order to facilitate the transient effect at the beginning of data tape scanning, the image may be supported by a suitable estimate of the process parameters. According to the local density of synchronization information, control-technical methods for continuing and controlling the image may be used, such as smoothing, production of mean values, disturbance variable compensation or adaptive control.

The areas illustrated in the figures as black or white may, of course, be interchanged. Black denotes low brightness of the image of the data tape on the sensor, white denotes high brightness, each relating to the color spectrum analyzed by the sensor. In this manner, colors being perceived by man as equally bright may appear in different degrees of brightness to the sensor due to filters or colored illumination of the data tape.

If the cells are divided up into fields and filled with preset patterns, the considerations with regard to synchronization on the inner structures of the cells may be expanded. On comparison of a cell with the possible patterns provided, for example, in the form of a two-dimensional cross correlation, the pattern with the highest conformity, corresponding to the highest correlation coefficient, may determine the data information pertaining to the pattern, comprising a plurality of bits, corresponding to a third dimension of the cell, while the position having the highest correlation coefficient, established by the two-dimensional cross correlation, may be included in the synchronization process as the central cell position. By the appropriate selection of the patterns to be provided from the entirety of possible patterns it is ensured that each cell may contribute to synchronization. Binary, digital or analogous brightness parameters may be used.

If binary brightness values are used, then the required comparisons may be replaced in a particularly simple manner by access to tables. In this case, the address required for the access to tables is compiled by the brightness

values, i.e. individual bits only, of the fields of the sensor coordinate system to be incorporated in the comparison or it is produced according to an algorithm while different output values, such as, for example, a field center coordinate, the data information searched for and/or quality identification for estimating the probability of correct data information are entered in the table under the respective address. By means of the latter an effect on the synchronization process may be suitably value weighted and an error correction algorithm for checking or correcting transfer errors may be improved. The table may be varied adaptively, for example, it may be adapted to a varying division of the target coordinate system or to a varying degree of brightness of the data tape.

Patent Claims

1. Method for synchronization in the decoding of information stored on data tapes having a high data density, in cells positioned two-dimensionally on the said data tape, using a surface or line sensor, **characterized** in that
   a) a specification is established describing the relative position of the fields of the sensor in relation to the position of the cells,
   b) the specification is continuously corrected in both dimensions using the relative position of the edges or inner structures of the cells, determined by using the sensor signals of the sensor fields.

2. Method according to claim 1, **characterized in that** the information content of a cell is determined by the sensor signal of a sensor field to be selected on the basis of the specification.

3. Method according to claim 1, **characterized in that** the information content of a cell is determined by the sensor signal of a plurality of sensor fields to be selected on the basis of the specification.

4. Method according to claim 3, **characterized in that** the information content of a cell comprises a plurality of data bits.

5. Method for encoding information and for recording the encoded information on a data tape having a high data density, which can be decoded by way of a method according to claim 1, **characterized in that** two-dimensional synchronous information is integrated into the inner structure of the cells positioned two-dimensionally on the data tape, containing the information to be stored.

6. Method according to claim 5, **characterized in that** the number of cells containing the same information in both dimensions is limited to small values in comparison with the respective dimensions of the entire data tape.

7. Method according to at least one of claims 5 to 6, **characterized in that** for representing the information content of a cell consisting of different fields characteristic patterns existing in the cell are used.

8. Method according to claim 7, **characterized in that** the different characteristic patterns, measured on average across the respective pattern, possess among one another identical or similar characteristics which are perceivable by man.

9. Method according to any one of claims 7 or 8, **characterized in that** the characteristic patterns consist of colors which appear in different degrees of brightness to the sensor.

10. Device for performing a process according to at least one of claims 1 to 4, **characterized in that** the sensor data are supplied to a detector, which determines from the latter the position of a cell in relation to the sensor coordinate system and its information content.

11. Device according to claim 10, **characterized in that** the device comprises a sensor, movable for scanning the data tape, a mean value producing means for centering the sensor coordinates of a row or column of the data tape, a storage means for storing the mean value, a subtracter for producing the difference between the last produced and the previously stored mean value and a control means for controlling the scan rate, to which the produced difference may be fed.

Title: METHOD AND DEVICE FOR SYNCHRONISATION IN THE ENCODING AND DECODING OF DATA THAT ARE PRINTED IN DATA TAPES
Inventor(s): Bernhard WIRNITZER et al.
DOCKET NO.: 016915-0253

10/009345

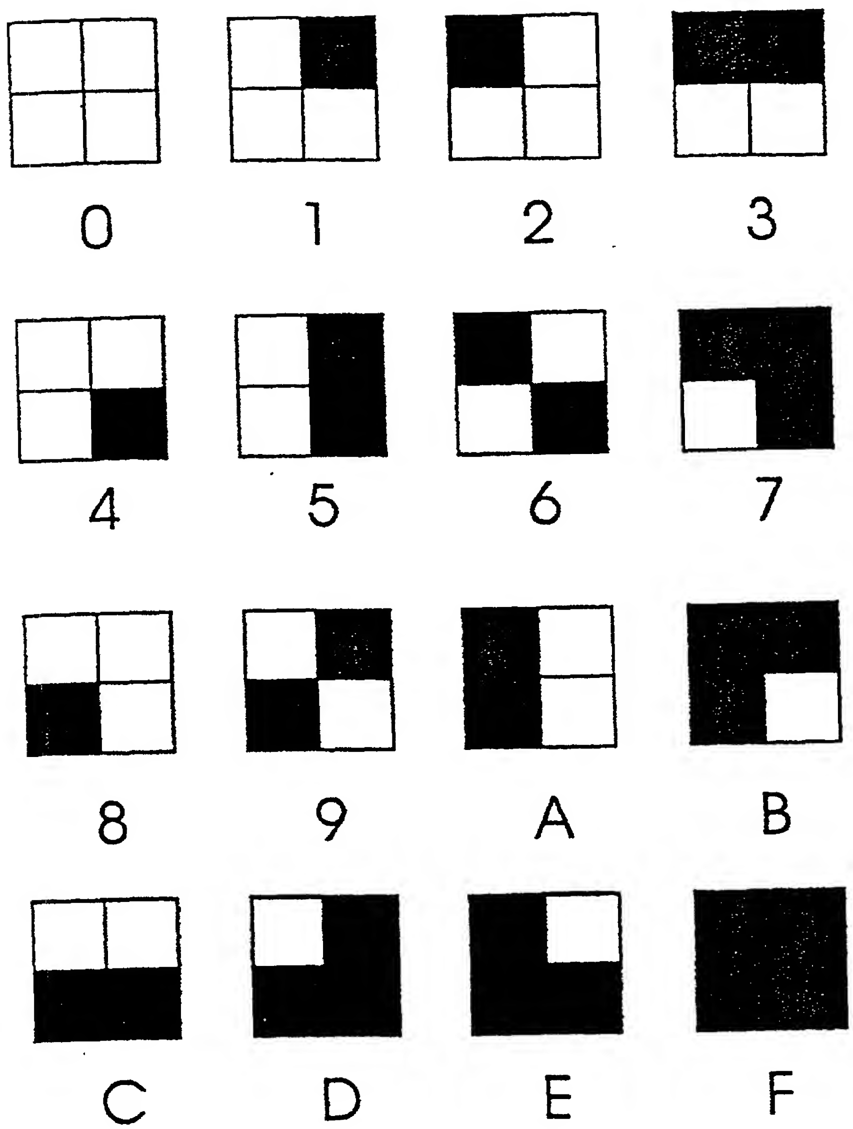

Fig. 1

Title: METHOD AND DEVICE FOR SYNCHRONISATION IN THE ENCODING AND DECODING OF DATA THAT ARE PRINTED IN DATA TAPES
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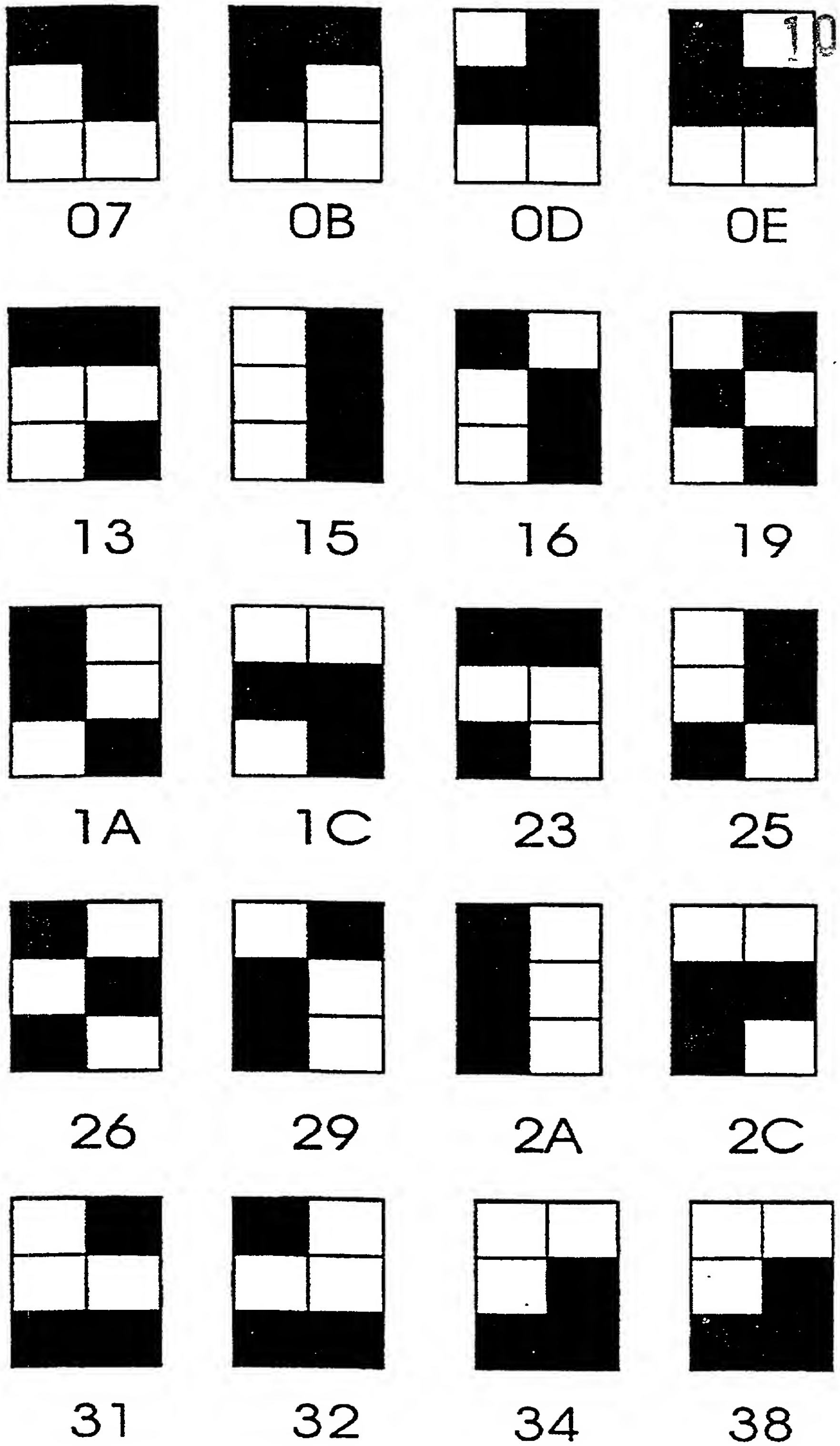

Fig. 2

Title: METHOD AND DEVICE FOR SYNCHRONISATION IN THE ENCODING AND DECODING OF DATA THAT ARE PRINTED IN DATA TAPES
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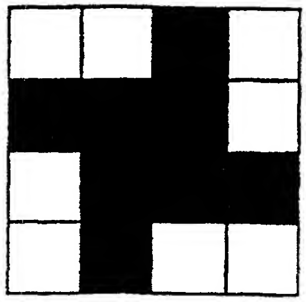
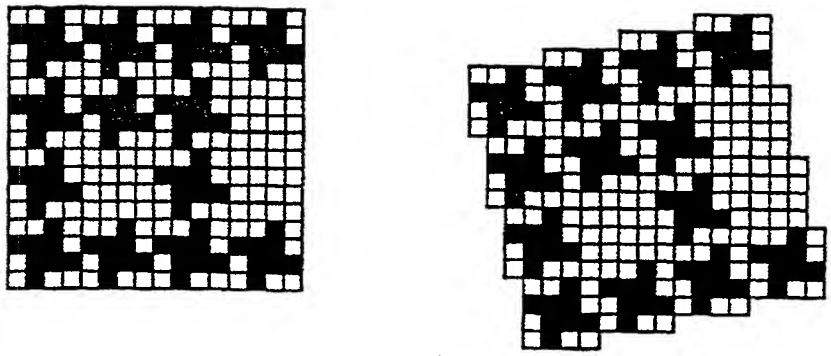


Fig. 3



A

B

Fig. 4

Title: METHOD AND DEVICE FOR SYNCHRONISATION IN THE ENCODING AND DECODING OF DATA THAT ARE PRINTED IN DATA TAPES
Inventor(s): Bernhard WIRNITZER et al.
DOCKET NO.: 016915-0253

10/009345

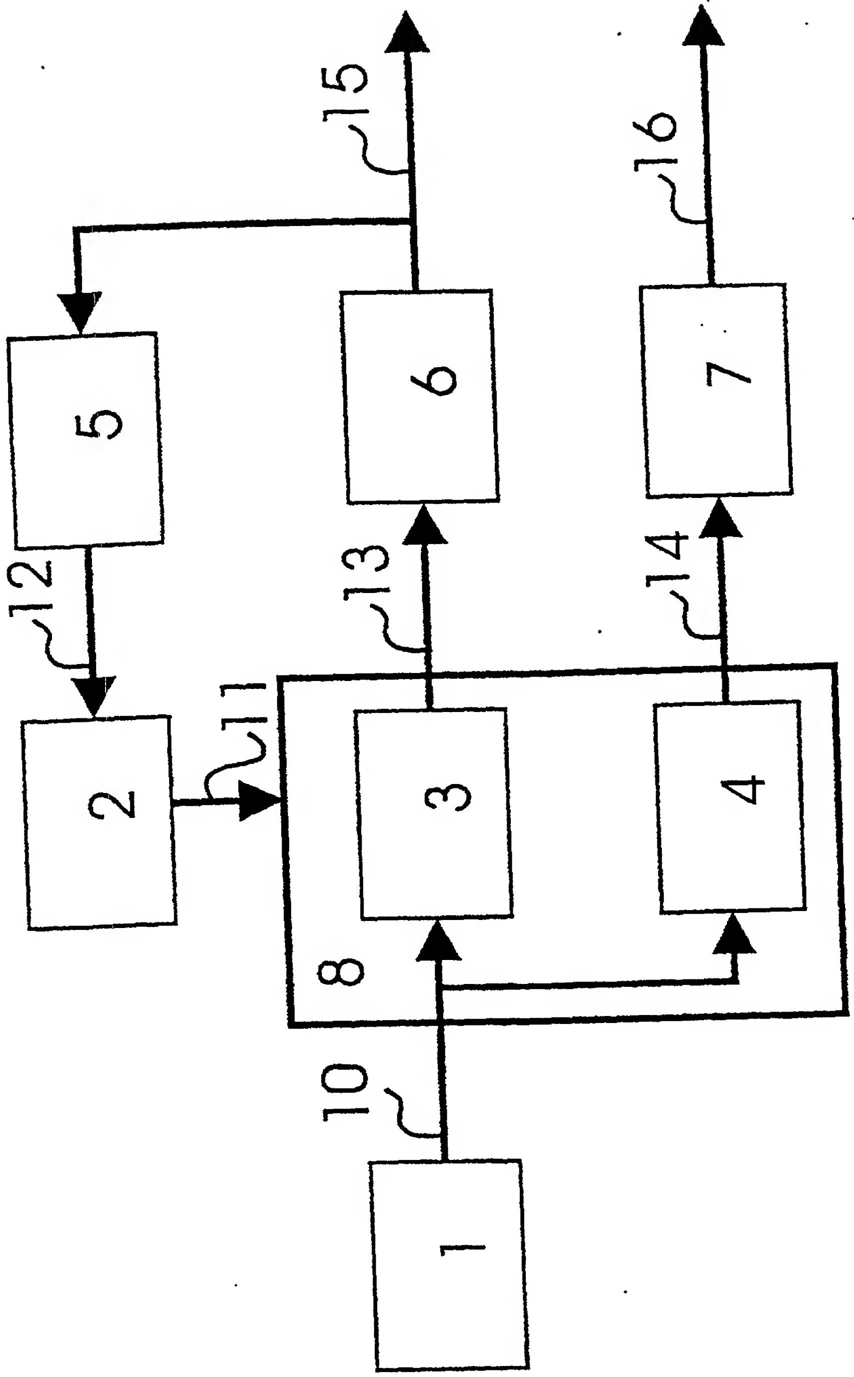


Fig. 5

10/009345

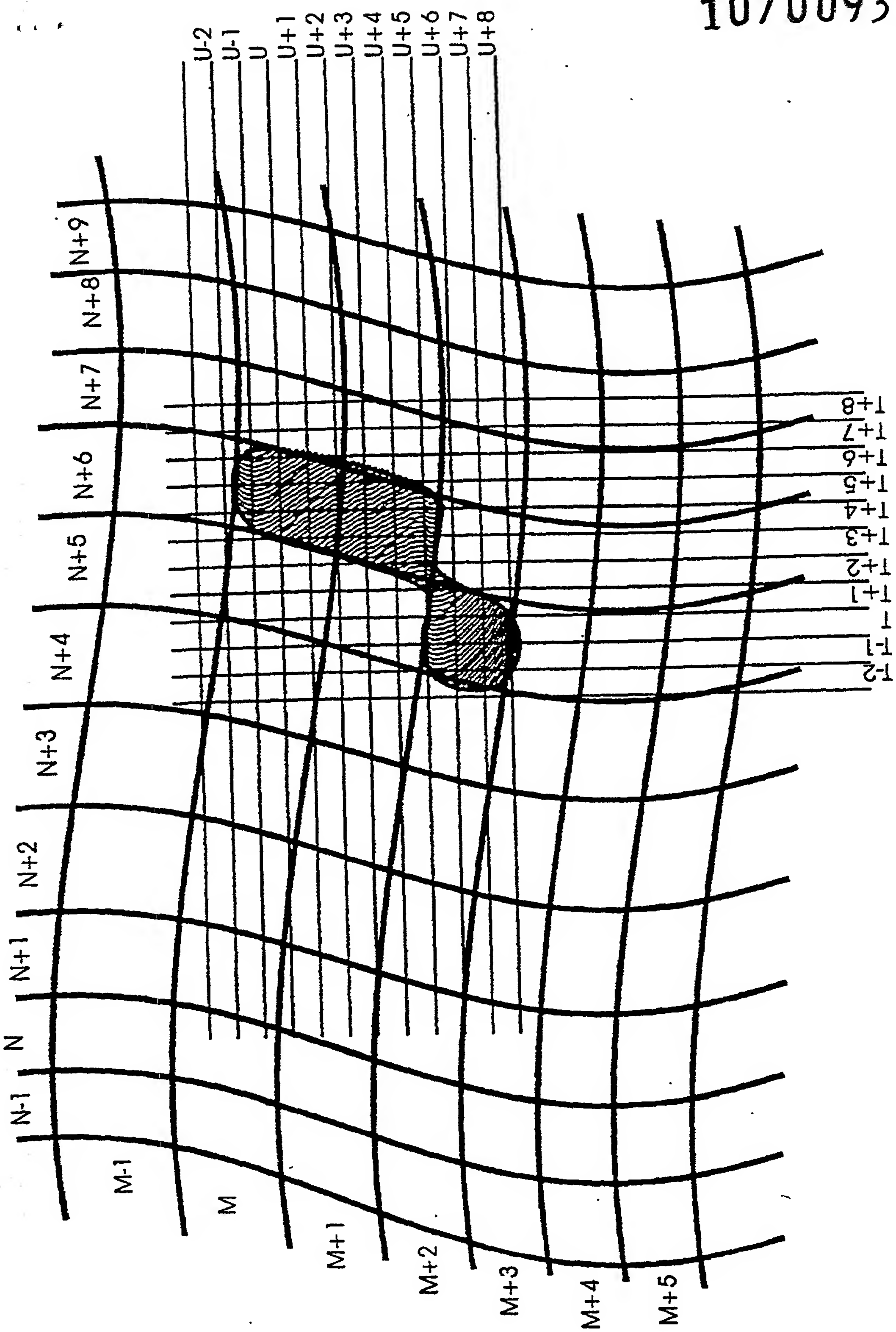


Fig. 6

dSer 4731 PGTUS

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I HEREBY DECLARE:

THAT my residence, post office address, and citizenship are as stated below next to my name;

THAT I believe I am the original, first, and sole inventor (if only one inventor is named below) or an original, first, and joint inventor (if plural inventors are named below or in an attached Declaration) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND DEVICE FOR SYNCHRONISATION IN THE ENCODING AND DECODING OF DATA THAT ARE PRINTED IN DATA TAPES

(Attorney Docket No. 016915-0253)

the specification of which (check one)

____ is attached hereto.

X was filed on June 9, 2000 as United States Application Number or PCT International Application Number PCT/EP00/05329 and was amended on December 7, 2000 and December 10, 2001 (if applicable).

THAT I do not know and do not believe that the same invention was ever known or used by others in the United States of America, or was patented or described in any printed publication in any country, before I (we) invented it;

THAT I do not know and do not believe that the same invention was patented or described in any printed publication in any country, or in public use or on sale in the United States of America, for more than one year prior to the filing date of this United States application;

THAT I do not know and do not believe that the same invention was first patented or made the subject of an inventor's certificate that issued in any country foreign to the United States of America before the filing date of this United States application if the foreign application was filed by me (us), or by my (our) legal representatives or assigns, more than twelve months (six months for design patents) prior to the filing date of this United States application;

THAT I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment specifically referred to above;

THAT I believe that the above-identified specification contains a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the invention, and sets forth the best mode contemplated by me of carrying out the invention; and

THAT I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I HEREBY CLAIM foreign priority benefits under Title 35, United States Code §119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number	Country	Foreign Filing Date	Priority Claimed?	Certified Copy Attached?
199 26 197.0	Federal Republic of Germany	June 9, 1999	YES	

I HEREBY CLAIM the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

U.S. Provisional Application Number	Filing Date

I HEREBY CLAIM the benefit under Title 35, United States Code, §120 of any United States application(s), or § 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application Number	PCT Parent Application Number	Parent Filing Date	Parent Patent Number

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to have full power to prosecute this application and any continuations, divisions, reissues, and reexaminations thereof, to receive the patent, and to transact all business in the United States Patent and Trademark Office connected therewith.

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I UNDERSTAND AND AGREE THAT the foregoing attorneys and agents appointed by me to prosecute this application do not personally represent me or my legal interests, but instead represent the interests of the legal owner(s) of the invention described in this application.

I FURTHER DECLARE THAT all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

180

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002.676425.1

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Inventor's signature		
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Inventor's signature	D. Meinerz
Date	January 28, 2002